

Acknowledgements

The *Steam Digest 2002* is the third annual compilation of articles dedicated to steam system efficiency. The U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy sponsors the BestPractices Steam program, which either directly or indirectly facilitated the creation of all the articles contained in this volume.

Since its inception, the BestPractices Steam program has been led by **Mr. Fred Hart** of DOE. **Dr. Anthony Wright** continues to direct the evolution of the program's technical content, notably including the development of software such as the Steam System Scoping Tool and the Steam System Assessment Tool. **Mr. Christopher Russell** of the Alliance to Save Energy conducts outreach on behalf of the program, making sure that program materials are properly distributed among state energy programs, utilities, trade associations, industry media, and the Internet. **Ms. Kristin Lohfeld** continues in this capacity as of March 2003. **Mr. Carlo LaPorta** of Future-Tec covers too many tasks to mention, and now is duly recognized.

Mr. Fred Fendt of Rohm & Haas now serves as Chair of the BestPractices Steam Steering Committee. **Ms. Debbie Bloom** of ONDEO-Nalco continues as Vice-Chair. These individuals participate on the BestPractices Steam Steering Committee:

Bob Bessette
Council of Industrial Boiler Owners
Victor Bogosian
National Board of Boiler and
Pressure Vessel Inspectors
Charles Cottrell
North American Insulation Manufacturers
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Introduction

Christopher Russell, Alliance to Save Energy

Fred Hart, U.S. Department of Energy

Dr. Anthony L. Wright, Oak Ridge National Laboratory

Why steam?

Steam—or more specifically the heat that steam provides—played a role in the production of virtually everything in the room around you. That includes the paper and ink in this document. It tempered the adhesives and fibers in wood-product desks and cabinets. Steam helped to manufacture your chair: plastics in the handles, foam cushioning in the seat, and the fabric covering as well as the pigments that color each of those items. Nuts, bolts, screws, and other metal fixtures were pre-heated with steam so that corrosion-retarding chemicals could be applied to them. The walls that surround you are probably made of either sheetrock or paneling, both of which were pressed from a steam-heated slurry of raw materials. Paints on your walls, pencils, and filing cabinets include polymers with a molecular structure that could only be assembled by high-temperature chemical reactions (again, facilitated by steam). The electric light by which you read was almost certainly produced by a steam turbine, fired by coal, natural gas, oil, or nuclear energy. And that bag of potato chips? The potatoes were “peeled” in a large, pressurized vat that accepted steam injection for 62 seconds, at which point the pressure was removed and the liquid content of the potatoes literally blew the skin off, leaving the potato whole.

That was only a short list of steam products.

Steam use in manufacturing can, and should, be part of any attempt by policy makers to address resource conservation, industrial competitiveness, energy market structure, and climate change. The following are facts that will substantiate¹:

- Thirty-five percent of all fuel consumed by industry for energy purposes is devoted to raising steam.
- Fuels consumed by steam systems (industrial, commercial and institutional) are roughly nine quadrillion Btu, or about one tenth of national primary fuel demand for everything, including transportation.
- A one percent improvement in industrial energy efficiency—which is technically easy to

accomplish—would return to energy markets a volume of fuel sufficient to satisfy the non-transportation energy needs of 3.2 million households.

BestPractices Steam is a U.S. DOE program that promotes steam efficiency. The program does not regulate or compel action on anyone's part. Instead, it simply identifies, documents, and communicates best-in-class steam management technologies and practices. These findings are made freely available in a series of reference documents, tip sheets, case studies, diagnostic software, and more—either printed or available for Internet download.

The articles in *Steam Digest 2002* represent a variety of operational, design, marketing, and program assessment observations. Readers are encouraged to also consult the 2000 and 2001 editions for additional reference. Please contact:

- U.S. DOE Office of Energy Efficiency & Renewable Energy Resource Room: (202) 586-2090;
- EERE Clearinghouse:
clearinghouse@ee.doe.gov (800) 862-2086;
- <http://www.oit.doe.gov/bestpractices/steam>; or
- <http://www.steamingahead.org>.

¹ All data from U.S. DOE Energy Information Administration

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Dr. Anthony L. Wright, Oak Ridge National Laboratory

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ENERGY EFFICIENCY AND INDUSTRIAL BOILER EFFICIENCY: AN INDUSTRY PERSPECTIVE

Robert Besette, Council of Industrial Boiler Owners

Consideration of energy efficiency for industrial boilers, more often than not, is simplified and categorized to a one-size-fits-all approach. This article addresses the four factors most critical for assessing energy efficiency in the industrial powerhouse supplying energy to make products for the benefit of customers in a highly competitive international marketplace.

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DECISION CLIMATE FOR STEAM EFFICIENCY: UPDATE DECEMBER 31, 2002

Carlo La Porta, Future-Tec

The Performance Evaluation and Policy Subcommittee of the BestPractices Steam Steering Committee issues a periodic compilation of data that the Energy Information Administration, U.S. Department of Energy, reports in its Short-Term Energy Outlook. The author selected data relevant to industrial decision makers concerned with supply and price of energy purchased for industrial fuel. The ulterior purpose is to help frame decisions that will encourage more investment to improve efficiency of industrial steam systems.

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AN ANALYSIS OF STEAM PROCESS HEATER CONDENSATE DRAINAGE OPTIONS

James R. Risko, TLV Corporation

The production and reliability performance of steam process heaters can be significantly affected by the condensate drainage design that is employed. The current variety of drainage options can be confusing to a system designer who is unaware of the reasons for each specific design. This paper provides us an understanding of the various types and why they may be used.

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COMBUSTION CONTROL STRATEGIES FOR SINGLE AND DUAL ELEMENT POWER BURNERS

David C. Farthing, Federal Corporation

Today's economic and environmental demands dictate that we get the greatest practical efficiencies from our plants. The use of more advanced automatic control systems for combustion control has proven to be an excellent example of systems and process automation success.

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INSULATION IMPROVES ECONOMIC RETURNS IN MANUFACTURING

Christopher Russell, Alliance to Save Energy

Mechanical insulation plays a role in optimizing a plant's valuable energy resources. Two tip sheets, part of a series of BestPractices Steam tip sheets that currently numbers 19, discuss the benefits of mechanical insulation and demonstrate the calculation of energy savings that it provides.

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REDUCE FUEL COSTS - USE THE PROPER AIR-TO-FUEL RATIO IN BOILER COMBUSTION

Christopher Russell, Alliance to Save Energy

Tony Tubiolo, Alliance to Save Energy

Opportunities for combustion improvement projects involve any or all of the following: boiler tune-ups, combustion control repair, burner repair, and repairs to existing oxygen trim systems. With an average payback period of less than half a year, optimizing steam system combustion is a proven and effective way to reduce operating costs.

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SAFETY ISSUES IN FOSSIL UTILITY AND INDUSTRIAL STEAM SYSTEMS

Otakar Jonas, Ph.D., P.E., Jonas, Inc.

The U.S. National Board of Boiler and Pressure Vessel Inspectors reports that 296 power plant boiler-related accidents (including 56 injuries and 7 deaths) occurred in 2001. This report presents results of recent surveys of safety issues in fossil utility and industrial steam systems.

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THE HUMAN SIDE OF ENERGY EFFICIENCY: THE VALUE OF TRAINING

Rachel Madan, Alliance to Save Energy

Many plant managers concentrate their efforts solely on technical improvements, ignoring the tremendous savings that can arise through low-risk, low-tech solutions such as training for proper maintenance and operation.

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PRELIMINARY RESULTS FROM THE INDUSTRIAL STEAM MARKET ASSESSMENT

Glenn P. McGrath, P.E., CEM, Resource Dynamics

Dr. Anthony L. Wright, Oak Ridge National Laboratory

This paper discusses fuel use and potential energy savings in the steam systems of three steam-intensive industries: pulp and paper, chemical manufacturing, and petroleum refining. The results indicate that to generate steam, the pulp and paper industry used 2,221 trillion Btu, the chemical manufacturing industry used 1,548 trillion Btu, and the petroleum refining industry use 1,676 trillion Btu. Preliminary results from the effort to determine potential steam system fuel savings are discussed.

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RESULTS FROM THE INDUSTRIAL ASSESSMENT CENTER (IAC) STEAM TOOL BENCHMARKING SUPPORT PROJECT

Dr. Anthony L. Wright, Oak Ridge National Laboratory

Dr. Kurt Bassett, South Dakota State University

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Dr. Ahmad Ganji, San Francisco State University

Derek Hengeveld, South Dakota State University

Dr. Richard Jendrucko, University of Tennessee, Knoxville

Dr. Dragoljub Kosanovic, University of Massachusetts, Amherst

Dr. Wayne Turner, Oklahoma State University

The U.S. Department of Energy's (DOE) Office of Industrial Technology (OIT) BestPractices effort is developing a number of software tools to assist industrial energy users to improve the efficiency of their operations. One of the software tools developed is the "Steam System Scoping Tool." Based on actual plant assessment experience, several DOE Industrial Assessment Centers (IACs) evaluate the Steam System Scoping Tool in this paper.

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PROSTEAM - A STRUCTURED APPROACH TO STEAM SYSTEM IMPROVEMENT

Alan Eastwood, Linnhoff March Ltd.

A spreadsheet-based steam cost model gives plant managers a clear and reliable understanding of their system and of any operational constraints. Models allow managers to identify and prioritize improvement opportunities before capital and other scarce resources are committed. ProSteam is one such analytical tool.

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STEAM SYSTEM IMPROVEMENTS AT DUPONT AUTOMOTIVE MARSHALL LABORATORY

Andrew Larkin, P.E., C.E.M., Trigen-Philadelphia Energy Corporation

Modifications to increase energy efficiency, reduce steam system maintenance costs, and implement small scale cogeneration are all cited in a Trigen-Philadelphia Energy Corporation recommendation for a campus composed of several buildings that are served by a district steam loop.

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CLOSED-LOOP ENERGY MANAGEMENT CONTROL OF LARGE INDUSTRIAL FACILITIES

Ronald L. Childress, Jr., Automation Applications, Inc.

This is a case study of a closed-loop control system installed and running at a pulp and paper facility in the southeast. A fuzzy logic, rule-based control system optimally loads multiple steam turbines for maximum electrical generation, while providing steam to the process. A Sell Advisor calculates Make-Buy decisions based on real-time electrical prices, fuel prices, and boiler loads.

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AN INTRODUCTION TO STEAM OUTSOURCING

Tom Henry, Armstrong Service Inc.

One evolving trend in the boiler replacement business is the movement to outsource the equipment, installation, and operation and maintenance--called the build, own, operate, and maintain (BOOM) market. Energy service companies (ESCOs) and lending institutions are developing services that respond to this emerging need.

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